



Measurement in the Software Process

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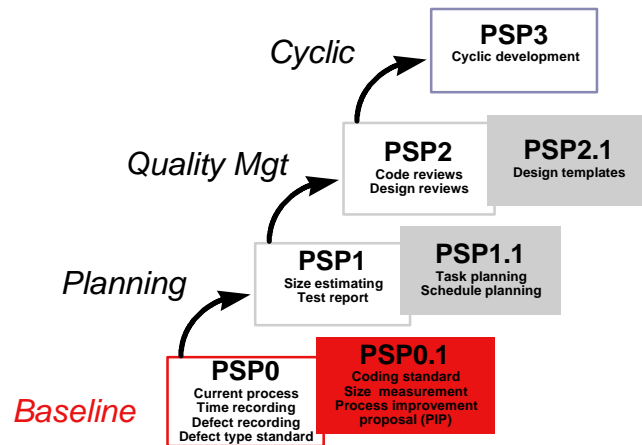
Outline

- *Review of PSP Levels*
- *Introduction*
- *Fundamental Process Measures*
- *The GQM Paradigm*
- *General PSP Objectives, Goals, & Questions*
- *An Example*
- *Gathering Data*
- *Impact of Data Gathering*
- *Establishing Your Baseline*
- *Homework #6*

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Review of PSP Levels (Humphrey, 1995, p. 11)



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Introduction (cf. Humphrey, 1995, p. 207)

- This chapter covers:
 - Principles of process measurement
 - The GQM Paradigm

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Why Make Measurements?

(cf. Humphrey, 1995, p. 207-208)

- To gain a quantitative understanding
- To evaluate a product, process, or organization
- To control a product or process
- To make an estimate or plan

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Principal Measurement Categories

(cf. Humphrey, 1995, p. 208)

- Objective / Subjective
 - count vs. judgment
- Absolute / Relative
 - invariant vs. change wrt others
 - Ex: program size vs. average
- Explicit / Derived
 - primary vs. secondary
- Dynamic / Static
 - time dimension vs. final result
 - Ex: To date vs. total
- Predictive / Explanatory
 - in advance vs. after the fact

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Mental Models (cf. Humphrey, 1995, p. 208, 209)

- **Definition**
 - A defined process
 - A defined context for data gathering
- **Conclusion**
 - "At least a basic process definition should always precede data gathering."
 - Each task should have explicit entry/exit criteria... (This is very difficult at times, especially for Analysis & Design.)
- **Start general and refine**
- **Benefits:**
 - Provides useful data
 - Ex: how long tests take
 - Ex: # of defects found in each type
 - Ex: Whether additional cost to find each defect is worth it
 - ...

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Fundamental Process Measures

(cf. Humphrey, 1995, p. 209-210)

- **Start with objective, absolute, explicit measures.**
- **Build derived ones upon these.**
- **Three categories of process measures:**
 - Product
 - Process
 - Resource

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Fundamental Process Measures (cont.)

(cf. Humphrey, 1995, p. 209-210)

■ *Product*

- Volume of product produced
- Ex: system capability (throughput, ...), complexity, ...

■ *Process*

- Process behavior
- Objective, absolute, explicit, dynamic
- Event counts & time measures

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Fundamental Process Measures (cont.)

(cf. Humphrey, 1995, p. 209-210)

■ *Resource*

- Labor hours are the primary resource.
- Secondary resources are tools & systems, support, ...
- You probably need to track time at the minute level
- Many types of "interruptions" reduce "productive" time:
 - meetings
 - lack of clerical service
 - poor support
 - phone calls
 - ...
- Three costs of these "interruptions":
 - lost time
 - additional time to get going again
 - increased likelihood of error
- Conclusion:
 - Track time to determine where and how to improve

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The GQM Framework

(cf. Humphrey, 1995, p. 211-214)

- GQM = Goals, Questions, Metrics
- Define primary (business related) goals for the activity (and for those above you in the organization).
 - What are you / they trying to achieve?
- Create questions, answer to which will help achieve these goals.
- Define / gather data necessary for answering the questions.

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GQM: The Goals Hierarchy

(cf. Humphrey, 1995, p. 212)

- Attempt to identify a hierarchy of organizational goals and relate your goals to the broader set.
 - What, how, when, how much, & improvement.
- cf. Fig. 7.1, p. 212, Goals Hierarchy

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GQM: Questions

(cf. Humphrey, 1995, p. 213)

- You are starting with rather vague goals and would like to end up with useful numbers (data collected, metrics).
- Questions are the connection between the two.
- Questions tell what you want to know about each goal.
- Ex:
 - For each process goal, where did I start, where am I now, and where do I want to go?
 - What is the best that has been achieved against this goal?
 - Is there a limit above which this goal cannot be improved?
 - cf. Manager/Developer GQM paper

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GQM: Metrics

(cf. Humphrey, 1995, p. 213)

- Metrics are the precise, exact ways you will collect the data.
- Start, be precise, recognize the need for additional data, and refine or add to the metrics you are collecting.
- Designing forms facilitates the data collection. It:
 - Is precise
 - Makes data collection easier
 - Improves the data-gathering efficiency
 - Helps point out weaknesses in the process
 - ...

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General PSP Objectives / Goals

(cf. Humphrey, 1995, p. 214)

- *The overall PSP data-gathering goals are:*
 - *Understand how personal SW development works*
 - *Determine steps to improve product quality*
 - *Determine the impact of process changes on your productivity*
 - *Establish benchmarks to measure process improvement*
- *You should:*
 - *Set more explicit goals*
 - *Start with learning about your process*

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General PSP Questions, Metrics, and Process

(cf. Humphrey, 1995, p. 214)

- *Questions:*
 - *What aspects of my performance are important?*
 - *How could I measure them?*
 - *What is the best performance I have achieved?*
 - *What can I learn from them?*
 - *What are others achieving?*
 - *What methods do they use that could help me?*
- *Metrics:*
 - *Define measures for the questions*
 - *Gather data on these measures*
- *Process:*
 - *Refine & improve*

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Some Examples

(cf. Humphrey, 1995, p. 215-217, and Turk, 1994)

■ Book's example:

- Goal: Produce defect-free programs.
- Question: How can you produce SW of such quality such that no defects will be found in later testing or use?
- Note: There is no way to guarantee this, but we can take steps to minimize it.
- cf. Table 7.1, p. 218,219, on how to update a Project Plan Summary when defects are found after development is completed - running it later or using it as the base for another program.

■ My Mgr/Dev GQM paper examples

- Look at paper

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Gathering Data

(cf. Humphrey, 1995, p. 217-226)

■ There are three issues with respect to gathering data, since you will probably not have special tools:

- Forms
 - You will need to create forms to facilitate the collection process.
- Place to keep the data
 - You will need to decide on a place to store the data.
- Engineering notebook
 - You will want a convenient place to record many kinds of thoughts and information, and log it for later reference.

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Gathering Data Manually

(cf. Humphrey, 1995, p. 217-219)

- *Tools would be nice, but personal judgment is necessary:*
 - *What category of activity are you engaged in right now? You need to log this. The computer cannot know this all the time.*
 - *Counting defects from code changes.*
 - *Determining where a defect was injected.*
 - *cf. Orlikowski*
- *Therefore, gather data manually.*
- *You can automate some of the analysis.*
- *There are readily-available tools:*
 - *Logs*
 - *Forms*
 - *Databases*
 - *Spreadsheets*
 - *Summary reports*
 - *...*

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Gathering Data: Forms & Templates

(cf. Humphrey, 1995, p. 219-220)

- *Definitions:*
 - *Forms = for fixed amount of data*
 - *Template = for unpredictable volume of data - expandable*
- *How to develop forms & templates*
 - *Use a test & modify cycle*
 - *Create the form and do a dry run with prior project data*
revise and do another dry run
 - *Finally test on a real project*
 - *Revise...*

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Gathering Data: The Defect Database

(cf. Humphrey, 1995, p. 220-221)

- Look at Table 7.2, p. 221, Defect Database Example
- Sample Uses:
 - Number of defects injected & removed by phase
 - Number & types of defects found in a specific phase
 - Number of defects in the product at phase entry, but which were not found during that phase
 - Time to fix a defect as a function of phase removed
- Suggestions:
 - Enter data promptly (post-mortem is a good time)
 - DBMS is a good method (spreadsheet could be used too)

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Gathering Data: The PSP Spreadsheet

(cf. Humphrey, 1995, p. 221-225)

- The spreadsheet has places for all Project Summary form data
- Walk through Table 7.3, p. 222-4
- Some potential analyses:
 - Regression - use spreadsheet
 - Yield = % defects removed in phase X...
 - Productivity
 - Development
 - Defect-finding in phase X
 - Charts - graphs, plot progress

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Gathering Data: The Engineering Notebook

(cf. Humphrey, 1995, p. 219-220)

■ *Uses & Value*

- *record thoughts (ideas)*
- *document ideas (patents, ...)*
- *prove competency (liability)*

■ *Practice: combine notebook & time log*

- *Page 1 = index*
- *Notebook from front and onward*
- *Log from back and forward*

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Impact of Data Gathering

(cf. Humphrey, 1995, p. 226-227)

■ *It takes time*

- *Time consuming and tedious*
- *You must be convinced of its value*
- *You must understand your goals, questions, and how you'll use the data*
- *This will guide your choice of what to keep / change about the PSP*

■ *It can affect your performance*

- *When you gather data for yourself - you can be objective*
- *When you gather data for your boss - you make the results look as good as possible*
- *Be careful / sensitive / private about how you share your personal data*

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Establishing Your Baseline

(cf. Humphrey, 1995, p. 227-228)

- You need a good volume of data to tell if you are improving.
- *Bolstering* = Selectively remembering good results
- *Clutching* = Results are so important that your performance is effected.
 - Ex: you must do well, and you don't, even though you usually do.
- Pressure introduces unknown factors which change your performance.
- Personal performance data can be discouraging, so focus on changing behavior, not simply on trying harder.

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Homework #6

- Program 6A
 - Enhance 4A linear regression to calculate prediction interval
 - See p. 757-758, and Assignment Kit #6

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